Characterization of NaOH gas attack on silica bricks by experimental alkali vapour tests and thermochemical modelling by FactSage™

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Silica bricks are used as refractory lining in the crown area of glass melting furnaces. During glass production the bricks are subjected to highly corrosive NaOH vapour evaporating from the subjacent glass bath. The interaction between NaOH gas and the refractory leads to a lowering of the melting point and the formation of alkali bearing SiO_2-rich melts within the product. A high volumetric amount and loss of the liquid phase appearing in the refractory could decrease the static stability and the lifetime of the glass furnace crown significantly. Thus, a detailed understanding about the atmospheric conditions favouring NaOH gas formation from the glass bath and its consequent interaction with the silica brick crown lining is of crucial importance to avoid lifetime shortening of the refractory. For that purpose, a mineralogical study by using a combination of experimental alkali vapour tests with thermochemical phase equilibrium modelling by FactSage™ and XRD-Rietveld analyses has been executed to evaluate the corrosive behaviour of a NaOH bearing glass furnace atmosphere on silica bricks. It is shown that a varying concentration of gaseous N_2, CO_2 and H_2O in the furnace atmosphere influences (1) the efficiency of Na_2O evaporation into NaOH gas and (2) the NaOH partial pressure that play a major role for the corrosive interaction with the silica bricks. Furthermore, the condensation behaviour of NaOH gas within the refractory and subsequent corrosion by liquid phase formation strongly depends on a temperature gradient developing in the product during operation.

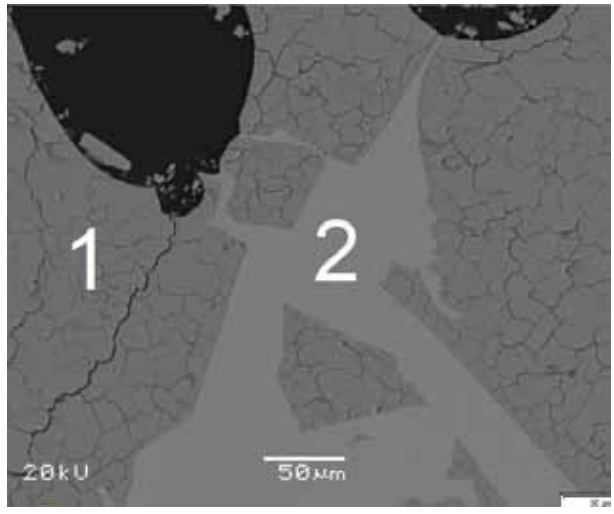

Figure 1. Micrograph of a typical silica brick after use in a glass melting furnace crown lining. Cristobalite (1). Glass phase (2).